Bacterial and Chemical Warfare

The Current Status

CECIL H. COGGINS, *M.D.*, Sacramento

• **For fourteen years public attention has been focused so sharply on atomic weapons as to lose sight of other, less spectacular but equally significant advances in the art of warfare.**

In the shadows cast by brilliant research in nuclear physics are hidden startling advances in the field of chemical and biological weapons. These weapons, as now developed, are not only capable of producing mass casualties quite comparable with those of atomic bombs, but they also possess certain advantages which may make them the weapons of choice for an unscrupulous enemy.

If war should come, it is the medical profession which will have the sole responsibility for protecting the citizens of California against these weapons, and we can therefore delay no longer in acquainting ourselves with their potentialities and characteristics.

In this task, we are working under two serious handicaps. The first is that our classical medical training affords little appreciation of the real danger, and the second is the cloak of secrecy surrounding the entire subject.

FOR THE PAST 14 years we have become so engrossed in the atomic bomb that we have lost sight of other advances in the art of warfare. We have forgotten that, while the physical scientists have been producing increasingly destructive weapons, the biologists and chemists have been equally busy. The result is that today we are faced with the possibility of war in which not one, but three terrible weapons may be used. Each one of these weapons is capable of producing mass casualties on a scale far beyond our previous experience and also beyond our present capacity to provide medical care.

While the destructive power of nuclear fission has become common knowledge, the real potentialities of biological and chemical warfare remain widely unknown. Unfortunately this is true, even among the medical profession, upon whose shoulders must inevitably fall the main burden of defense. This dangerous situation, in which we are expected to protect the public against weapons which are unknown to us, cannot be allowed to continue. We must become informed of the facts.

We were not taught in medical school how diseases can be deliberately produced in man nor how the atmosphere may be rendered lethally poisonous. Yet today, somewhat paradoxically, our national security demands that we know a great deal more about biological and chemical warfare than was previously thought fit for our ears.

CHEMICAL WARFARE

What are the facts about chemical warfare? In modern times war gases were first used by the German army against the Allies in 1915. We quickly retaliated; and before the war had ended, chlorine, phosgene, chlorpicrin, mustard and the arsenicals were in general use. Although these early gases were crude and the methods of delivery primitive, they nevertheless caused 1,300,000 casualties and, in doing so, proved to be five times as efficient as either shrapnel or high explosive shells.[3] This was a clear warning of things to come, but forty years have now passed, and each year has been marked by notable advances in chemistry.

After World War I a steady stream of new chemicals came from the laboratories, passed through the stages of research, development and large scale production and finally found a place in military stockpiles. Of these, distilled mustard, the nitrogen mustard series and Lewisite each boasted of a killing power twice as great as phosgene. In 1920, when they learned about Lewisite, the public wishfully concluded that war had at last become too frightful ever to occur again.

Equally important was the constant improvement in methods of delivery. The old fashioned candles, projectors and land mines gave way to new chemical artillery shells, grenades, mortar shells, aerial bombs, airplane spray tanks and finally to rockets. Nearly every projectile in the armaments of the world was adapted to carry chemicals as readily as explosives. It is an historical fact, and one of the most curious in all history, that World War II was fought to its bloody end by military forces, all of whom were afraid to use the chemical weapons in their possession.

But they were not forgotten. Even while fighting with conventional arms, the Germans developed the

Presented as part of a Symposium on Disaster Medical Care at the 89th Annual Session of the California Medical Association, Los Angeles, February 21 to 24, 1960.

Assistant Chief, Medical and Health Division, State of California Disaster Office.

series of organophosphates now known as the nerve gases Tabun (GA), Sarin (GB) and Soman (GD). Twenty times more toxic than hydrogen cyanide, these gases were so deadly that they frightened Hitler. They had the power to cause casualties before they could be detected by the human senses; they were lethal after less than a minute of exposure and their liquid droplets quickly penetrated the skin.[3]

In the body, nerve gases react with cholinesterase irreversibly, thus permitting the accumulation of acetylcholine and, consequently, the continuous uncontrolled stimuation of the parasympathetic nervous system. The resulting spasmodic muscular contractions cause dimness of vision, respiratory difficulty, salivation, involuntary elimination and convulsions ending in death.

It is therefore easy to understand why, having captured the German Tabun plant intact, the Russians triumphantly moved it home to Russia, together with the top ranking German chemists and technicians. As a result, Tabun is now the standard Russian nerve gas and the present Soviet stockpile is estimated at more than 50,000 tons. To understand what this means, we need only note that this quantity is quite sufficient, under the usual conditions of gas dispersal, to wipe out the population of a thousand cities the size of San Francisco.

What have we done to meet this threat? Although the official United States policy has always been that we will not resort to lethal gas unless the enemy uses it first, we have tried to develop a retaliatory capability. Our standard nerve gas is Sarin (GB) and we built a plant at Rocky Mountain Arsenal in Denver for large scale production. However, this plant has since been shut down, partly because of complaints from Denver residents against the proximity of so deadly a munition. To replace the Denver facility, the Chemical Corps has now begun converting an Atomic Energy Commission plant at Newport, Indiana, for the manufacture of nerve gas—at a cost of 13.5 million dollars.

Whether we can overtake the Russian lead is now problematical. The chief of army research and development, Lieutenant-General Arthur Trudeau, admits that we are lagging behind and that we do not now have a counter-offensive capability.

The nerve gases are now standard equipment, but they are already twenty years old and soon they will be joined by more modern and even more deadly chemicals. Today there are, in advanced stages of development, not only war gases of much higher toxicity, but also an entirely new category of chemical weapons designed, not to kill, but to incapacitate. These weapons fall into two groups: Those which produce temporary physical disability such as blindness, paralysis or deafness; and those which cause temporary mental aberration. The great strategic advantage offered by gases that are capable of liberating captured cities while, at the same time, sparing the lives of friendly civilian populations, has given new impetus to chemical warfare research on both sides of the Iron Curtain.

One of the most promising of the new psychochemicals is lysergic acid diethylamide, derived from the ergot fungus. Another is mescaline from the peyote cactus. A third is psilocybin, found in the vision-inducing "divine mushroom" of Mexico.

Preparations of these and other agents are available either as powders or liquids. The liquids can be sprayed into the air to form aerosols which spread across the ground like a fog. Physiological effects are the same whether the new substances are breathed, swallowed or injected parenterally. They variously produce hallucinations, depression, apathy or senseless elation lasting from 12 to 24 hours. The ability to integrate time and distance is lost. The aviator cannot fly a plane and the soldier cannot aim a gun.

These new agents, called by the soldiers "loony gases," have already been tested on a large number of human volunteers. Troops exposed to one of them were not even conscious of their abnormal condition, which was so changed that they were unable to follow simple commands or to perform normal tasks with acceptable accuracy. Only an outsider, not exposed and observing them, could recognize their behavior as eccentric and erratic.[3]

The Russians are well aware of the possibilities inherent in the psychochemicals, and they will certainly be redoubling their efforts to be first in the field with fully operational munitions. Soviet Major General Yu V. Drugov, of the military medical service of the Red army, recently stated, "Special interest attaches to the so-called psychic poisons mescaline, methedrine and lysergic acid derivatives which are now used for the simulation of mental disease."[3]

Such cautious statements do not reveal the full extent of Russian readiness to wage chemical war. Their total military forces number over 8 million men in more than 400 divisions. Each division has a unit devoted to chemical warfare, with chemical troops assigned to all echelons down to the battalion level. Their chemical weapons are modern and effective, and so is their protective equipment. Their stock of war chemicals is enormous, comprising fully 15 per cent of their total military munitions.

The entire population of the Soviet Union is deadly serious about chemical warfare. Their civil defense organization, DOSAAF, requires 22 hours of instruction, plus practical exercises, for all adults between the ages of 16 and 60. Protective masks are sold at government stores throughout the coun-

try. Thirty million Russians have completed their training and now wear the qualification medal. For more details on Soviet preparedness, I refer you to House Report 300 of the 86th Congress, filed by the Committee on Government Operations.[1]

BIOLOGICAL WARFARE

Let us briefly consider biological warfare. This is defined as the intentional use of living organisms, or their toxic products, to cause death, disability or damage to man, his domestic animals or crops.

In learning the truth about biological war, the civilian physician labors under very serious difficulties. Up to the present, he has not been permitted to share the knowledge which his military colleagues have learned in secret. At the same time, his habits of thinking, moral convictions and humanitarian instincts all combine to produce in his mind a strong antipathy for the subject. This antipathy commonly expresses itself in indifference or disbelief.

It must be clear, however, that if we are to defend against biological agents, we must know their capabilities. This has been the underlying purpose of the intensive program of biological warfare research which has been carried out in this country for the past 17 years. Under the Army Chemical Corps, research and development is centered in the permanent laboratories at Fort Detrick, Maryland, but collateral investigation has been done in many other laboratories by hundreds of our leading bacteriologists. Their laboratory findings have been tested by field trials under a great variety of conditions. The results leave little doubt of the enormous potentialities of disease when used as a weapon of war.

However, in order to appreciate the power of these weapons, one must first understand how they will be used. Perhaps the most effective method of biological attack is by means of an aerosol. Today, aerosols can be delivered to any point on the earth's surface by generators incorporated into aerial bombs, airplane spray tanks, submarine mines and guided missiles. These generators consist basically, of containers of highly concentrated slurry of bacteria, viruses or toxins, fitted with fog nozzles, from which the contents are sprayed into the air under pressure to form a fine mist. Spreading rapidly downwind, the mist quickly becomes invisible. Under neutral or inversion conditions, 50 gallons of slurry is capable of blanketing an area of 60 or more square miles with a high concentration of infectious particulates.[2]

Trials have repeatedly shown that the cloud penetrates every building, even when not assisted by air circulation systems. The smaller particles diffuse through structures in much the same manner as a gas and many secondary effects occur, such as the widespread contamination of kitchens, restaurants, food stores and hospitals.[2]

If, at this very moment, such a cloud were released over Los Angeles, we would have no choice, if we continued to breathe, but to take into our lungs large numbers of virulent organisms. It is obvious that the consequences of such an attack would not be influenced in any way by the high standards of our Public Health Services, but instead would depend entirely upon the enemy's choice of agent, the dose inhaled and our own individual resistance to the infection.

In the process of verifying the feasibility of such attacks, a great number of research problems have been encountered. They have had to do with the selection of the proper agent for the immediate effect desired; the large-scale production, storage and mechanical delivery of high concentrations of agent; the protection of living agents against unfavorable meteorological conditions during delivery, and finally, the assurance that a sufficient number of particulates of the optimum size can be successfully lodged in the alveoli of the lungs.

We have found none of the problems to be insuperable and it must be assumed that the Russians, who have been doing such research six years longer than we, have come to the same conclusions. Indeed, in a lecture given three years ago, Colonel Adam Milkovich of the Moscow Institute stated, "In a practical sense, the question of the possibility of the use of biological warfare weapons in future wars is not considered today a subject open to debate, for it is known that an enemy can successfully attack human beings, and even animals and plants, with biological agents." And he added, "From results of comparative studies of the losses of life from conventional weapons, war poisons and atomic energy on one side, and losses from biological weapons on the other, it is believed today that a biological war would have the greatest effect of all."[4]

Let us consider what agents an enemy might use in such a war. His choice would be influenced by a number of factors. Among these are: The effect desired, whether early death or disabling illness; the incubation period; prevailing weather conditions; target population susceptibility; persistence of contamination and the possibility of retroactivity. Regardless of prevailing conditions, from his wide spectrum of available agents, an aggressor should be able to select several which would meet his requirements.

Among the bacterial diseases, anthrax, plague or glanders would be expected to produce a very high mortality, while brucellosis, tularemia and bacillary dysentery would disable for a considerable period. The rickettsiae would offer typhus for high mortality, with Q fever and Rocky Mountain spotted fever

able to seriously obstruct defensive efforts. Similarly, the viruses of psittacosis, equine encephalitis, influenza and even variola could reasonably be expected to override existing immunities to harass and hamper the defense.[3]

In visualizing the many possibilities, we must constantly keep in mind that we are not talking about these diseases as they naturally occur. On the contrary, we are describing the military exploitation of massive amounts of highly infectious agents, introduced through unusual portals of entry.

Many agents are much more toxic or infectious when they enter the lungs than by the natural portal. The alveolar bed is highly susceptible to infection—entrance to the alveoli amounts almost to intratissue inoculation. Botulinal toxin, for example, is several thousand times more toxic by this route than when it is swallowed. Tests on human volunteers show that the median infective dose for man in Coxiella-burnetti aerosols is one billionth of a gram of embryonated egg material.[2] The high mortality of primary plague pneumonia is well known and a number of other organisms are in the same category.

Although the diagnostic problems presented by the atypical diseases resulting from aerosols may prove to be difficult, nevertheless it is we who will be called upon to solve them.

DEFENSE

I do not wish to leave you with the impression that defense is impossible. On the contrary, defense against both biological and chemical weapons is both feasible and practicable by means which are known and which need only to be put into operation.

Our national government, through the Office of Civil Defense Mobilization, is now initiating a public information program dealing with chemical and biological weapons. Defensive measures to be taken are outlined in the recently issued National Biological and Chemical Warfare Defense Plan (Annex 24) to the National Plan for Civil Defense and Defense Mobilization. Biological and Chemical Warfare defense equipment is being distributed to federal, state and local agencies. One month ago, California was allotted 320 chemical protective equipment sets, including 2,560 gas masks, for training purposes. Plans call for a civilian gas mask to be placed on the market this year.

It is the local governments, however, who have the responsibility for education and training and for perfecting their Civil Defense organizations. As citizens, we are part of our community Civil Defense effort, and, as physicians, we are responsible for the medical aspects of our Civil Defense. With greater awareness of these responsibilities and with the active participation of every doctor, the job will be done.

Medical and Health Division, State of California Disaster Office, P. O. Box 110, Sacramento 1.

REFERENCES

1. Civil Defense in Western Europe and the Soviet Union, Report by the Committee on Government Operations, U. S. House of Representatives, 86th Congress House Report, 300:39-100, April 1959.

2. Fothergill, L. D.: Biological Warfare and Its Defense, Proceedings Medical Civil Defense Conference, A.M.A. Council on National Defense, pp. 22-40, June 1958.

3. Research in CBR, Report of the Committee on Science and Astronautics, U. S. House of Representatives, 86th Congress House Report, 815:4-12, Aug. 1959.

4. Summary Report, American Chemical Society Board Committee on Civil Defense, Chemical and Engineering News, 37:77-78, Oct. 1959.

Films for C.M.A. Annual Session Film Symposia Requested

The previously successful film symposia presented during the California Medical Association annual sessions will be repeated in 1961, April 30 to May 1.

Daytime symposia, each one to center around one specialty, are now being planned for the physician. General programs for doctors, their wives, nurses and ancillary personnel will be presented during the evenings.

There will be a moderator and outstanding physicians, preferably authors, as discussants on each symposium.

Authors desiring to show their films should notify Paul D. Foster, M.D., California Medical Association, 2975 Wilshire Boulevard, Los Angeles 5.

Deadline: December 1, 1960.